# DIY

***Worthwhile projects you can build on your own***


## Short 160-meter vertical antenna

During one Winter Field Day, around 1 am, I had exhausted every 80-meter SSB (single sideband) contact I could hear. Then, after calling CQ for nearly an hour, I decided to check out the other bands. 40 meters had gone to sleep. 20 meters was non-existent. So, for grins, I decided to tune up on 160 meters. What I found surprised me. CW...SSB...some digital noise. The party had moved to 160 meters! After logging a few contacts there, my faith was restored.

Even among the bravest amateurs, why is it that most hams shy away from 160 meters? Seems the biggest reason is the need for a monster antenna. (Misguided beliefs that nobody uses that band also plays into the mystery, IMO.) A 160-meter dipole is 468 ÷ 1.8 MHz = 260 feet long. And it needs to be at least ¼ wavelength, or 160 m ÷ 4 = 40 m (132 feet) off the ground! Who has that kind of real estate? Not me.

Enter the Short 160-meter vertical antenna. I say *short* because it's only 25 feet tall, much shorter than the required 130-foot height of a 160-meter vertical antenna would be. It still uses 250 feet of radiating wire, but it's helically wound, essentially making an antenna out of a huge loading coil. But because of the resulting inductance introduced by this coil, the short vertical requires a capacitance *hat* to compensate. This design was adapted from one by John Miller, K6MM, highlighted in *QST*, June 2009, p. 32—36.

### Parts list

One 10-foot 2″ PVC pipe
One 10-foot 1½″ PVC pipe
One 10-foot 1″ PVC pipe
One 2″ PVC slip cap
One 1″ PVC slip cap
Two 36″ long 1/8″ brass rods
Two bullet splice male for 22 AWG
Three bullet splice female for 22 AWG
One 4″x ¼″ eyebolt, washer, wing nut
One 3″ x 3/16″ eyebolt, washer, wing nut
One #4 x 14 AWG ring terminal

250 feet 22 AWG stranded insulated wire
13 feet 18 AWG stranded bare copper wire
Four 131 feet 14 AWG stranded insulated wires
Two black binding posts
One SO-239 bulkhead connector
Duct tape
One bullet splice male for 14 AWG
Four ¼″ ring terminals for 14 AWG
Two M3-0.5 mm x 14 mm machine screws
Two M3-0.5 mm hex nuts and split washers
Three #8 x 14 AWG ring terminals

### Construction

Cut 2 feet 6 inches off the 1″ PVC pipe to make it 7 feet 6 inches. Clean and then cover two inches of one end (we'll call the *bottom* end) of the 1″ PVC pipe with fifteen or sixteen turns of duct tape. Clean and then cover the area on the 1″ PVC pipe between 9½ and 11½ inches from the bottom end. Clean and then cover two inches of one end (we'll call the *bottom* end) of the 1½″ PVC pipe with seven or eight turns of duct tape. Clean and then cover the area on the 1½″ PVC pipe between 22 and 24 inches from the bottom end.

Slip the 1″ PVC pipe bottom end into the 1½″ PVC pipe top end 11½ inches, with the edge of the duct tape flush with the pipe top. Drill a 3/16″ hole through both pipes between the duct tape, about 4 inches from the top of the 1½″ PVC pipe. Remove the 1″ PVC pipe from the 1½″

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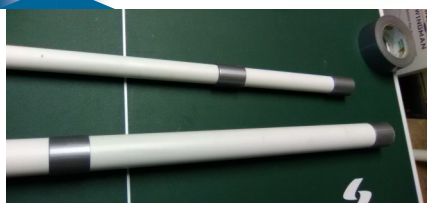
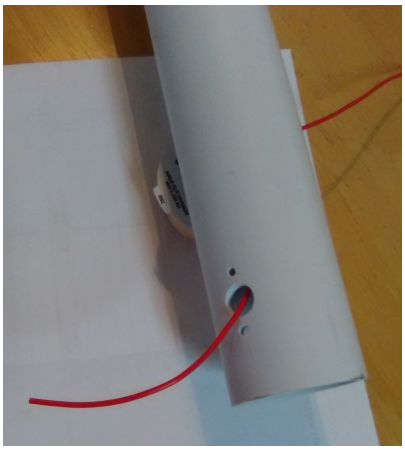
PVC pipe and set it aside. Slip the 1½″ PVC pipe bottom end into the 2″ PVC pipe top end 24 inches, with the edge of the duct tape flush with the pipe top. Drill a ¼″ hole through both pipes, about 4 inches from the top of the 2″ PVC pipe. Remove the 1½″ PVC pipe from the 2″ PVC pipe and set it aside.



***Duct tape applied***

On one end of each 131-foot wire, connect a ¼″ ring terminal for 14 AWG. These are the radials, which you'll connect to the black binding posts when you're ready to use the antenna. Drill a ½″ hole about two inches from the bottom end of the 2″ PVC pipe, insert the SO-239 bulkhead into the hole, with two opposite anchor holes of the bulkhead aligned vertically, then mark and drill those two holes in the PVC pipe and remove the bulkhead connector.



Cut two 3-inch pieces of 14 AWG wire. Connect a #8 ring terminal to each end of one of the 3-inch wires. On the other 3-inch wire, connect a #8 ring terminal to one end and a #4 ring terminal to the other end. Drill a 1/8″ hole in the 2″ PVC pipe opposite the ½″ hole and about six inches from the bottom end. Drill two 3/16″ holes about two inches from the bottom end of the pipe and about a third of the way around the pipe from the ½″ hole, one in each direction. Slip one end of the 250-foot 22 AWG wire into the 1/8″ hole from the outside of the pipe, then slip it out through the ½″ hole, strip that end, then solder it to the center pin of the bulkhead connector.

Install the two black binding posts into the 3/16″ holes and connect them on the inside of the 2″ PVC pipe by the three-inch wire with the #8 ring terminals. Install the SO-239 bulkhead connector into the ½″ hole, and secure it with the M3-0.5 mm screws. Connect the other three-inch wire on the inside of the 2″ PVC pipe between one of the black binding posts and one of the bulkhead connector screws. Place the 2″ slip cap on the bottom end of the 2″ PVC pipe.

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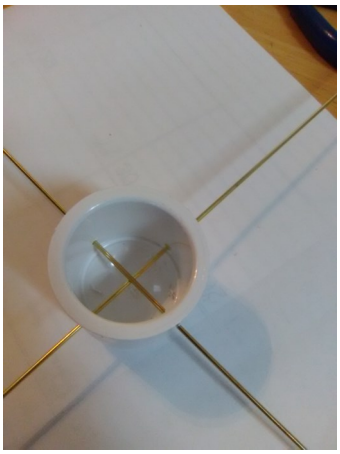
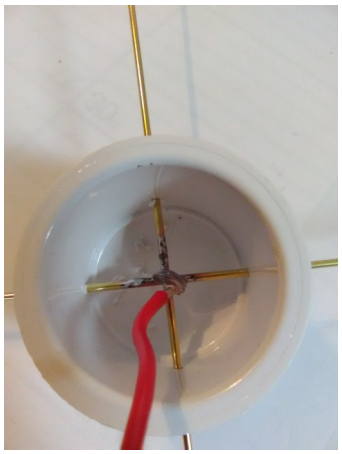
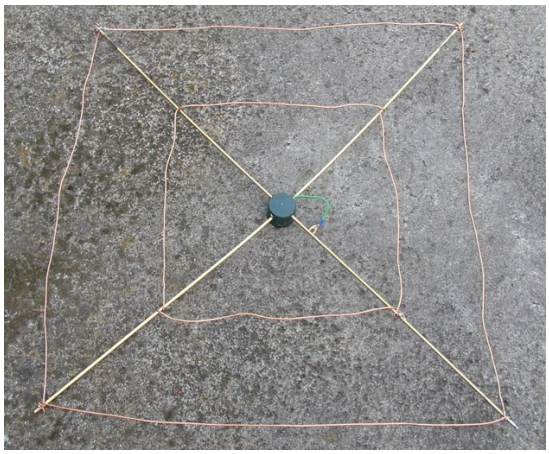
## The capacitance hat

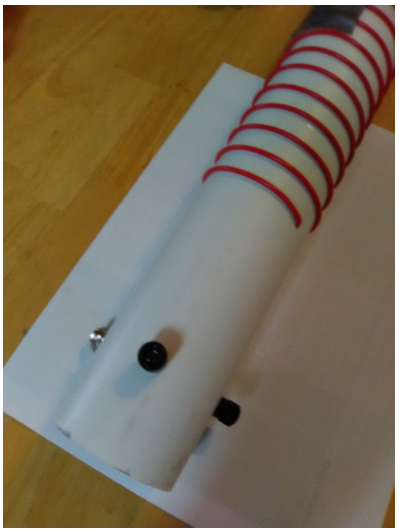
Drill two 1/8″ holes about an inch from the edge of the 1″ slip cap and opposite from each other. Drill two more 1/8″ holes about 1/8″ closer to the edge of the cap, but 90 degrees away from the first two holes. Slip the two brass rods into the cap, such that they cross and contact each other, and stick out of the cap equally in all directions. Connect a bullet splice male to one end of a ten-inch piece of 14 AWG wire, and strip about an inch off the other end. Wrap the stripped end around the junction of the brass rods and solder the wire to both rods.







Tie and solder (about 102 inches of) the stranded bare copper wire around the ends of the four brass rod tips. Tie and solder (about 51 inches of) the stranded bare copper wire around the mid-points of the same four brass rod sections. This completes the capacitance hat, which will sit on the top of the 1″ PVC pipe, and connect to the end of the 250-foot 22 AWG wire.



## Winding the helix

With one end of the 250-foot wire already connected to the SO-239 bulkhead connector, begin wrapping the 250-foot 22 AWG wire around the 2″ PVC pipe tightly, ensuring about ½″ spacing between each turn. It might help to use a few pieces of duct tape every dozen turns, to help hold the winding in place. Once you reach the top of the 2″ PVC pipe, cut the wire and install a bullet splice female onto one wire and a bullet splice male on the other.

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Insert the bottom of the 1½″ PVC pipe into the top of the 2″ PVC pipe, and continue winding the 22 AWG wire around the 1½″ PVC pipe. Once you reach the top of the 1½″ PVC pipe, cut the wire and install a bullet splice female onto one wire and a bullet splice male on the other. Insert the bottom of the 1″ PVC pipe into the top of the 1½″PVC pipe, and continue winding the 22 AWG wire around the 1″ PVC pipe. Once you reach the end of the 22 AWG wire, drill a 1/8″ hole in the 1″ PVC pipe about three inches from the top, and slip the end of the 22 AWG wire into the hole. Terminate the 22 AWG wire with a bullet splice female.

## Using the antenna

When it's time to use your short 160-meter antenna, attach the capacitance hat to the 1″ PVC pipe and connect the bullet connectors. Connect the other two sections and their bullet connectors and securing eyebolts. Attach two of the radials to one of the binding posts and two to the other. Stand the entire assembly upright, securing the bottom section on the ground, and use guy cord to hold it in place. Spread the radials out as far and as widely as possible.

Now, get on the air and see what the 160 meter band has to offer! You might find that a vertical, shortened though it might be, can bring you more DX (long distance) contacts than a dipole, due to its low takeoff angle. But because it's shortened, it definitely won't be made for QRP (low-power operation), and might require you to run at a full 100 watts.

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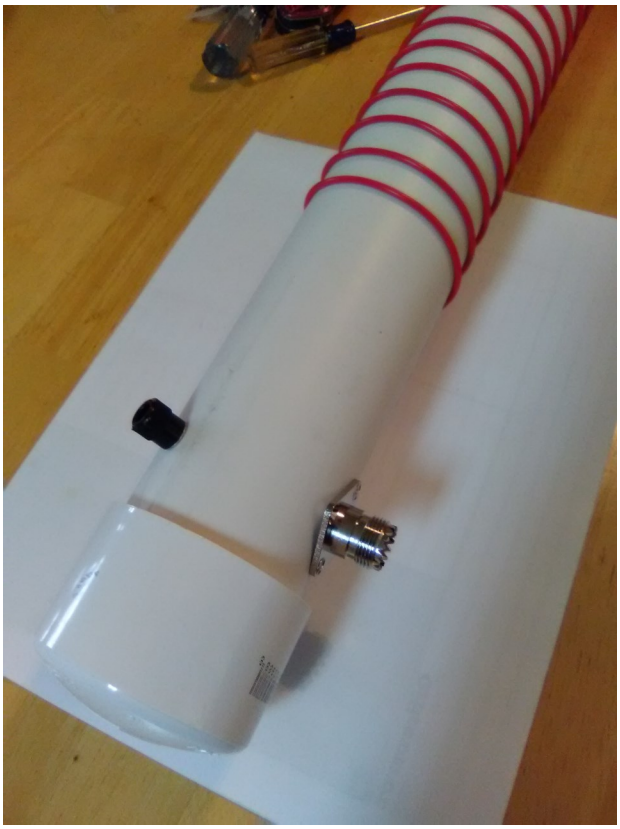

***Painted and erected***